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Leak Lookout: Using External Leak Detectors to Prevent Petroleum Contamination from Underground Storage Tanks

(U.S.) Environmental Protection Agency, Washington, DC

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Office of
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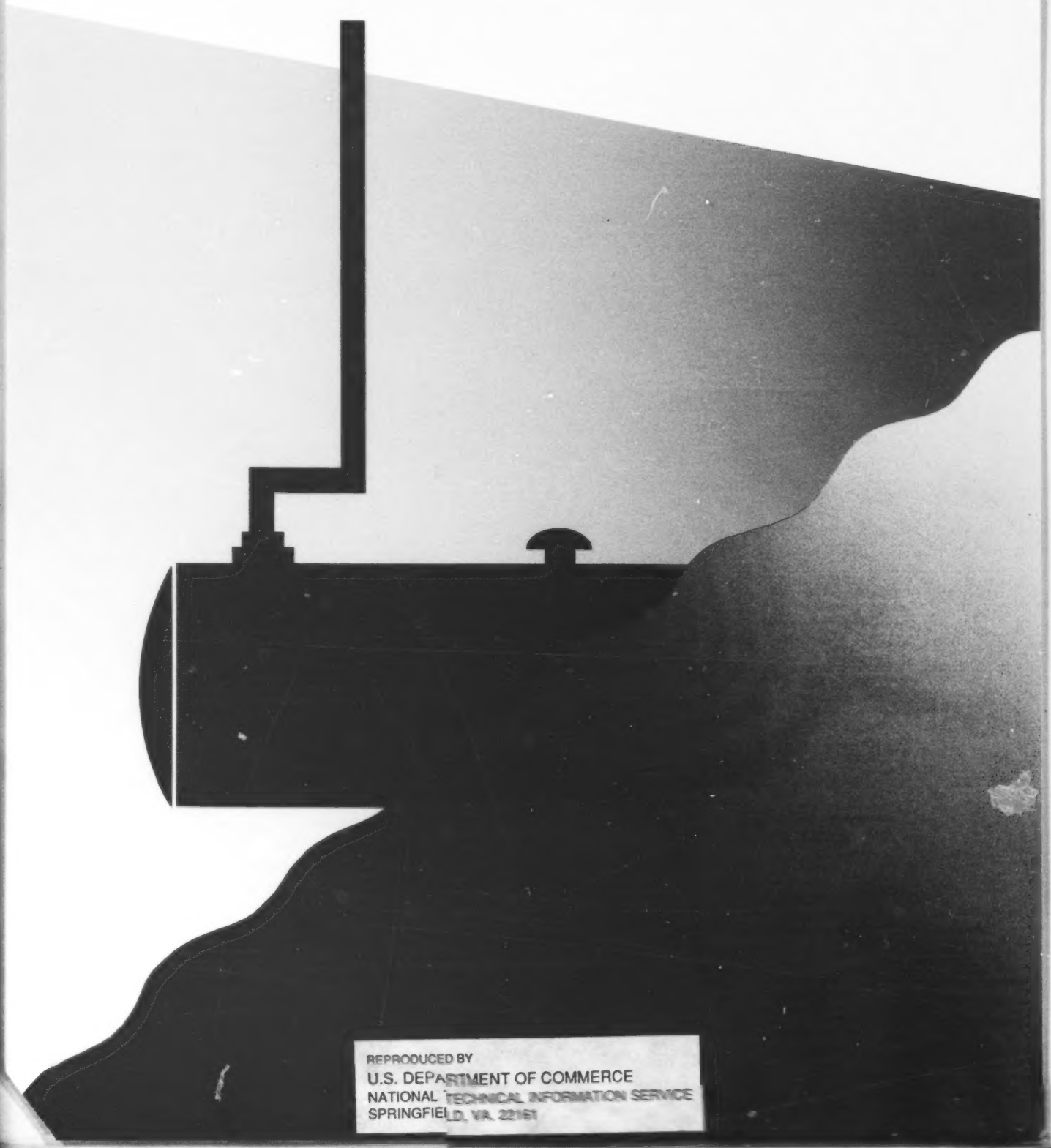
Leak Lookout



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16. ABSTRACT

This booklet was written for owners and operators of underground storage tanks that hold petroleum products such as gasoline, diesel fuel, or oil. The Federal regulations require that these systems have leak detection. This booklet briefly describes **external** leak detectors. It does not recommend which product to buy or rank equipment from best to worst, but gives background needed on **external** devices so owners and operators can ask the right questions when speaking to vendors about their products.

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Using External Leak Detectors to Prevent Petroleum Contamination from Underground Storage Tanks

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NOTICE

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Acknowledgement

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LEAK LOOKOUT

Why Worry About Leak Detection?

Because your tank or its piping may leak. As many as 25 percent of all underground storage tanks (USTs) may now be leaking. Many more will leak in the near future--possibly yours. In fact, your tank or its piping might be leaking now, although you may not know it. If a tank system is past its prime (that is, over 10 years old), especially if it's not protected against corrosion, the potential for leaking increases dramatically. Newer tank systems, particularly the piping, can also leak. Don't let your profits drain away.

Because it's the law. And it's the law for a good reason. Much of our country depends upon ground water for drinking water, and leaked or spilled petroleum can contaminate this vital resource. Explosions are another potential hazard of leaks. Federal requirements for tank systems, excluding home heating and small farm tanks, will become effective at the end of 1988. Many State and local governments already require specific steps to prevent, detect, or clean up leaks; and others will soon have similar requirements. Check with your State and local governments to learn what requirements apply to you.

Because it's in your best interest. Leaking UST sites can be very costly to clean up. Imagine how much money you'd lose if your tank could not be used for weeks during lengthy cleanups or if local residents sued you for property damages. The costs can run into the thousands--perhaps as much as $500,000 and more. Detect and clean up leaks before they hurt you financially.

Because it's for the good of your community and the environment. Petroleum leaks can have serious and far-reaching consequences, such as the contamination of soil, drinking water supplies, and air. Petroleum and its resulting poisonous vapors can also accumulate in nearby confined spaces, such as septic tanks and home basements, and can cause fires or explosions. Communities across the nation have suffered disasters resulting from petroleum leaks. Don't let it happen to yours.

How Can This Brochure Help Me?

If you own or operate an underground storage tank that holds petroleum products such as gasoline, diesel fuel, or oil, you should know that there are detectors on the market that can warn you about a leak. If you choose an external leak detector, this brochure will help you select the best one for your underground storage tank. It won't tell you which product to buy or rank equipment from best to worst, but it will give you the background you need on external devices to ask the right questions when you speak with vendors about their products. You should also check with the State or local agency responsible for underground storage tanks in your area to find out what rules apply to you. (If you are not sure which agency to contact, start with your local fire department.)

This brochure will answer questions about:

- The purpose of external leak detectors;
- Equipment and installation costs;
- Compatibility with your current tank;
- The types of detectors on the market;
- How external leak detectors work;
- The pros and cons of various types of equipment; and
- What companies sell external leak detectors.

What Companies Sell External Leak Detectors?

Vendors who responded to a survey by the U.S. Environmental Protection Agency are listed at the end of this brochure. The U.S. Environmental Protection Agency does not endorse any specific product or company, nor does this list include all companies that sell external leak detectors.

What Kinds of Leak Detectors Are Available?

There are two basic types of leak detectors--*external leak detectors* and *internal leak detectors*. This brochure explains only *external leak detectors*, which are installed outside the underground storage tank and warn you if petroleum liquid or vapors are present in monitoring wells near the tank. Some models respond primarily to petroleum liquids while other models respond to petroleum vapors. *Internal leak detectors* monitor the fuel level inside the underground storage tank itself. There are a number of different types of internal leak detectors. Internal leak detection will be described in a future publication.

How Does an External Leak Detection System Work?

An external leak detection system has two main components: (1) the leak detector itself, and (2) one or more monitoring wells. External detectors range from simple, hand-held devices to sophisticated automatic equipment. If a leak occurs, petroleum liquid and vapor flow into nearby monitoring wells near the tank, where they are detected by the leak detection device. Some detectors use sensors located inside the monitoring wells to trigger an alarm in a central control panel; others test samples of water or air taken from the wells. (See Figure 1, below).

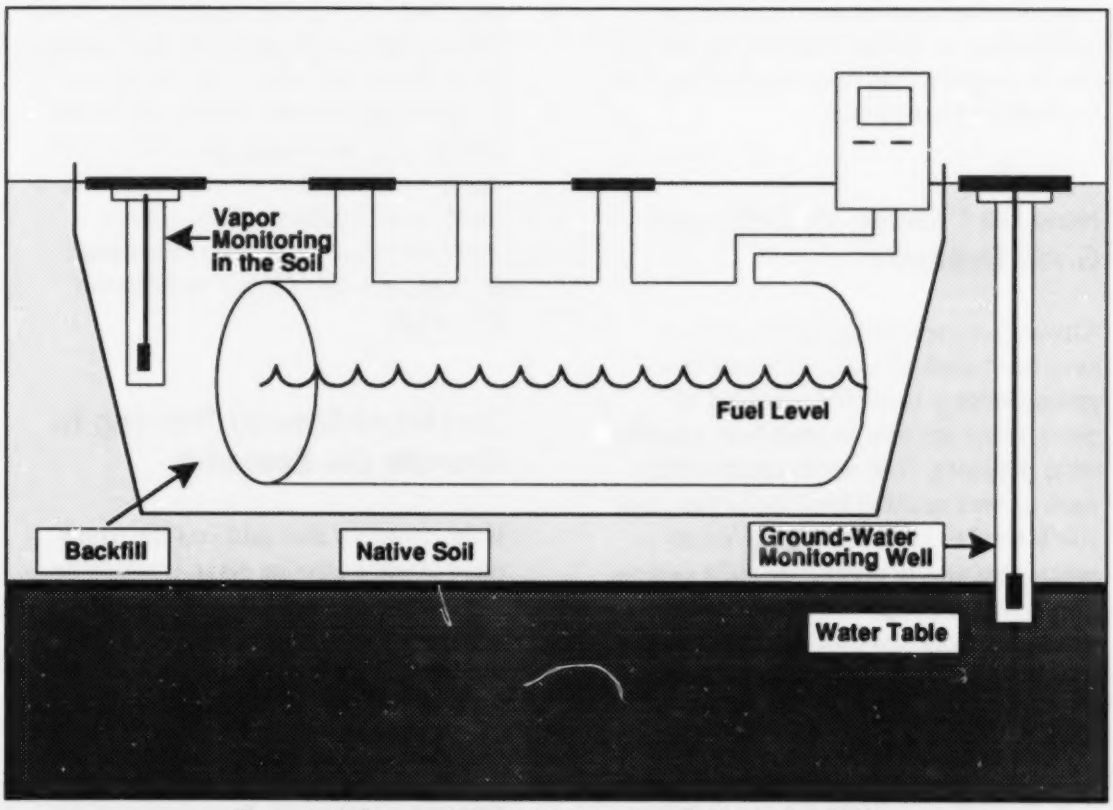

Figure 1. Underground Storage Tank System with Monitoring Wells

How Much Will It Cost?

External leak detectors range in price from about $100 for a basic manual detector to more than $14,000 for a high-end automatic system. Detectors that respond to petroleum vapors are usually more expensive than those that respond to liquid.

Installation costs, which include the cost of putting in the monitoring wells, vary considerably. But maintenance is relatively inexpensive for most models. By doing some comparison shopping, you can find an external leak detector that does the job and fits your budget.

How Do I Know I'm Getting a Good System?

Although some external leak detectors have been used with petroleum underground storage tanks for a number of years, many are new or have been used for other purposes. The newer models may work as well as those used in the past, but you'll need to make an extra effort to ensure that you're getting the right system. That's why it's important to talk with several vendors and obtain as much information as possible about their products. Find out how long their equipment has been on the market and how it has been used in the past. You'll also want to check to make sure the equipment you purchase meets State and local requirements.

Your leak detector should come with detailed operating instructions and be backed by a warranty. You should have the detector checked every year by the company that sold you the equipment to ensure that it is working properly.

Can I Install the Leak Detector Myself?

No, it takes someone with specific technical knowledge to install monitoring wells and leak detection equipment. In addition, some States require installer certification, and others may do so in the future. Many vendors install leak detectors and monitoring wells themselves. If not, they can usually recommend an experienced contractor to do the installation. Remember, this is a lifetime investment that can save you trouble and money in the future. Don't try to cut corners on installation and end up with a system that doesn't do the job.

Do I Need Special Training to Operate the System?

If the company that sold you the equipment offers a training class, it would be worthwhile to attend. If not, ask the company's representative to walk you through the testing procedures, and see if there is a "hotline" number to call if you have a problem. Be sure to read and follow all instructions that come with the detector whether you have a manual or automatic device.

Who Should Be Responsible for the Leak Detector?

If you can't do it yourself, you should depend on a person who will follow the monitoring and testing procedures outlined in the instructions and record all readings accurately. The benefit to you is protection against ground water contamination, which can be very costly to clean up.

Can I Use an External Detector with My Current Tank?

In most cases, the answer is yes. But you have to consider two key factors: (1) the type of *backfill* in the excavation zone surrounding the tank (tank systems are buried in an "excavation zone," which extends from 1 to 3 feet beyond the tank on all sides), and (2) whether the soil around the tank has been *contaminated* by petroleum.

Backfill: Leak detectors work best when a porous material such as pea gravel or sand is used for backfill within the excavation zone. Leaking liquids and vapors flow rapidly through this type of soil to monitoring wells.

Clay soils, which are not porous, should not be used as backfill with an external detection system, because clay will delay leaking petroleum--particularly liquid petroleum--from reaching monitoring wells. However, an external detector can be used in an area with clay soil as long as a porous material is used as backfill. Most underground storage tanks installed in recent years have a pea gravel backfill, but many older tanks are surrounded by whatever type of soil happens to be at the site.

The equipment installer should check the type of backfill and the level of existing contamination before installing your leak detector. You should check with the vendor or installer to make sure that these tests are performed and that the device you plan to buy will work under the conditions at your site. Find out if your vendor has installed other leak detectors in your area and whether there have been any problems.

Existing contamination: If you install a leak detector at your existing tank site, it must be able to detect any new leaks even though there may already be contamination from a prior leak or spill. External leak detectors work best when the soil and ground water near the tank are clean.

What Kind of Equipment Do I Need?

There is a wide range of equipment to choose from. In the survey of vendors, the U.S. Environmental Protection Agency identified nearly 50 companies that sell external leak detectors, and many of them offer several models. There are other companies that sell external leak detectors that were not covered by the survey.

External leak detectors come in two categories--those triggered by liquid fuel and those that react to vapor.
In addition, some leak detectors are "intermittent," which means you must perform manual tests at regular intervals, while others are "continuous"--they operate automatically. Here are some things to consider when deciding which type will best suit your needs:

Liquid vs. **Vapor**

Liquid detectors: Liquid detectors work best in areas where the ground water is close to the surface, making the soil around the tank wet. Leaking fuel seeps down through the soil to the ground water and floats on the surface of the water as it is carried to monitoring wells. Liquid detectors are suitable for use with most petroleum products.

Vapor detectors: Vapor detectors work best in places where the ground water is deep and the soil around the tank is dry. However, vapor detectors will work in shallow ground water conditions if sensors installed in the monitoring wells are not actually under water. Vapor detectors react more quickly to leaks than liquid detectors, because vapor spreads more quickly than liquid. But vapor detectors are highly sensitive and, therefore, more likely to give false readings, and they may require more maintenance than liquid devices. Vapor detectors work best with fuels that produce a large amount of fumes, such as gasoline.

Manual vs. Automatic

There is no simple rule to help you decide whether to use a manual leak detector or an automatic one. The decision depends on a number of factors including your financial resources, the soil around your tank, the number of tanks and sites, and the fuels being stored. Here are some things to consider:

Manual detectors: Manual detectors are easier to use and less expensive than automatic devices; but they require monthly tests at all tank locations, and a record must be kept of the results. Manual detectors let you know immediately if petroleum liquid or vapor is present in a monitoring well, although they only work when you are testing.

If you can take the time to do the tests and keep accurate records of the results, a manual system may be cost-effective. If not, you're probably better off with an automatic system.

Automatic detectors: Automatic detectors are usually more expensive than hand operated ones; but they can be less time consuming to operate, because you don't have to perform routine tests as you do with manual devices. Automatic detectors are working all the time and will send a warning signal if petroleum liquid or vapor enters a monitoring well. Some devices send the signal within minutes after petroleum is detected; others can take as long as 20 minutes. Except for regular maintenance, you don't have to spend much time monitoring the system.

However, just as vapor detectors are more likely to give false readings than liquid detectors, sophisticated automatic devices are more likely to malfunction than simpler manual detectors. You could think of an automatic detector as a race car that needs to be kept in tip-top condition for peak performance, while a manual detector is more like the basic sedan--it doesn't go as fast as the race car, but it can still get you where you are going.

Special Cautions

Response time: Although most automatic detectors respond rapidly once petroleum liquid or vapor enters a monitoring well, the time it takes to reach the well varies greatly depending upon soil and water conditions and the location of the wells. The more porous the soil around the tank and the closer the monitoring wells are to the tank, the more quickly leaking petroleum will reach the well.

Interference: Many automatic leak detectors, and some manual devices, react to chemicals, vapors, and other substances in the ground or air that are unrelated to your petroleum underground storage tank. When this occurs, it can cause the detector to send a false warning or miss a real tank leak. Ask your vendor what interferences may affect the leak detector you plan to buy and find out what you can do about them.

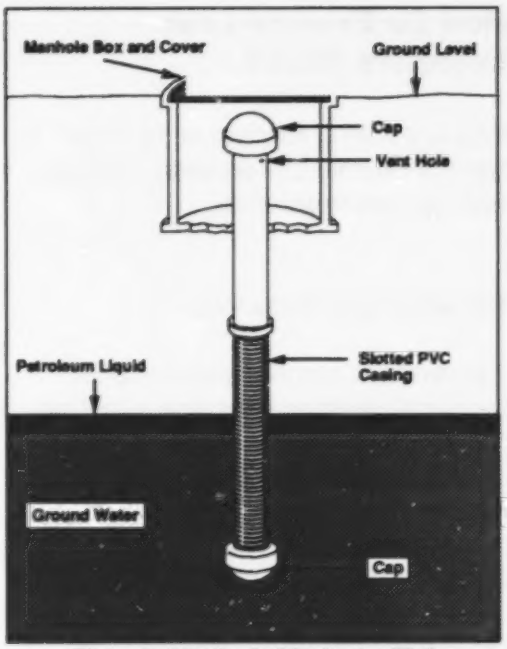

Figure 2. Details of a Monitoring Well

How Many Monitoring Wells Do I Need?

Naturally, the more you have the better your chances of finding a leak. Whatever the number of monitoring wells, however, you do not necessarily need more than one leak detector. If you are using a manual detector, you can test different wells with the same equipment. If you have an automatic detector, sensors in each well are connected to a central control panel. However, you may need additional leak detectors if you have tanks at several locations. (Figure 2 above , illustrates the components of a typical monitoring well.)

How Do External Leak Detectors Work?

Here is a brief description of the main types of external leak detectors and their strengths and weaknesses:

Manual Liquid Detectors

The two most commonly used manual liquid leak detectors are "grab samplers" and chemical-sensitive pastes. In grab sampling, a clear container with a valve on one end--known as a bailer--is lowered into a monitoring well and then removed. If fuel is present, layers of petroleum will be suspended in the water like an oil slick. In the second method, a tape measure treated with special paste is placed in a monitoring well. If fuel is present, the paste changes color. (See Figure 3, next column.)

Strengths: Manual liquid detectors are widely used because they are inexpensive, accurate, and easy to operate.

Weaknesses: Manual liquid detectors provide limited information about the type of contamination found. (However, chemical analysis can identify the material collected by grab sampling.) They do not allow for continuous monitoring as do automatic devices; therefore, someone must take time to perform routine tests.

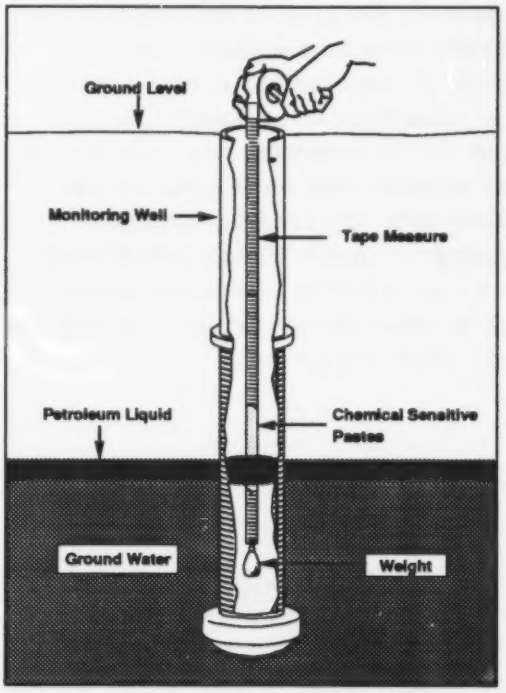

Figure 3. Chemical-Sensitive Pastes with Tape Measure

Automatic Liquid Detectors

There are three types of automatic liquid detectors. Interface probes operate by beaming light through a probe located in a shaft near the tank. If there is liquid in the shaft, the light beam is interrupted and a signal goes off in the control panel; another sensor determines whether the liquid is water or petroleum. Another type, known as a product soluble device, has a cable or hose made of material that dissolves in petroleum. The cable or hose

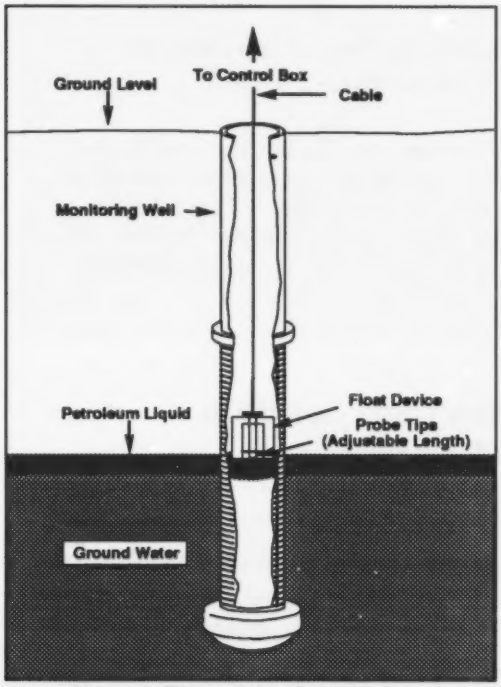

Figure 4. Thermal Conductivity Sensor

is suspended in a monitoring well, and if petroleum is present, it will dissolve the material and trigger an alarm. A third, the thermal conductor, uses a sensor with a heating element that floats in a monitoring well. If petroleum is present, a change in the rate of heat loss triggers an alarm. (See Figure 4, above.)

Strengths: Some automatic liquid detectors have been on the market for 15 years, and thousands of them are in use. The central control panels have a long service life and can accommodate multiple sensors. One type--the product soluble device--detects both petroleum liquid and vapor.

Weaknesses: Interference by ultraviolet light, water vapor, ice, and other substances can trigger false readings. The response time varies from one model to another.

Manual Vapor Detectors

There are at least six different categories of manual vapor detectors. The basic mechanism is that a sample of water or air from a monitoring well comes into contact with a flame, heating element, ultraviolet light, or other material within the detector. If petroleum is present, an electrical or chemical change occurs and can be seen by reading a meter or gauge.

Strengths: Some manual vapor detectors have been commercially available for 10 years, and many are currently in use, although not necessarily for petroleum underground storage tank leak detection. They are highly sensitive and respond within seconds. Some models can identify the exact material that has been detected. Control panels have a long service life.

Weaknesses: Manual vapor detectors require special maintenance, making them time consuming to operate. They are subject to interference, which can result in false readings. The central control panels usually support only one sensor; if you have more than one monitoring well, you will need additional devices. However some devices are portable so you only need one even if you have more than one monitoring well.

Automatic Vapor Detectors

There are three main types of automatic vapor detectors. The metal-oxide semiconductor works on the principle that petroleum vapor will cause a change in the electrical current in a cell inside the detector. A variation on this model, called an adsistor or diffusion sensor, uses the same principle but operates somewhat differently. Another variety, known as a product permeable device, uses materials that allow vapor but not water to penetrate into the detector. Once the vapor is inside, the detector operates the same way as a metal-oxide semiconductor. A third type, the catalytic sensor, works by bringing an air sample into contact with heated filaments. If vapor is present, the temperature inside the detector will rise and trigger an alarm.

Strengths: Automatic vapor detectors are new to the underground storage tank market, but thousands of these devices have been used during the past decade for other applications. Some models can tell you what type of material has been detected. They are highly sensitive and have a rapid response time. The control panels have a long service life and can accommodate multiple sensors, which last from 1 to 10 years.

Weaknesses: Automatic vapor detectors are subject to interference from a wide range of substances, which can cause false readings.

Does the Federal Government Endorse These Products?

To repeat, the U.S. Environmental Protection Agency does not endorse companies or products. The vendor list included in this brochure is solely for your information, and it does not include all companies that sell external leak detectors.

How Can I Get More Information?

A more detailed description of the devices discussed in this brochure plus additional information on external leak detection are available. You may order the U.S. Environmental Protection Agency's complete report, "Survey of Vendors of External Petroleum Leak Detection Devices for Use with Underground Storage Tanks," from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, (202) 783-3238. Please request stock number 055-000-00277-1.
The cost is $4.25.

For specific requirements that apply to your tank, please call your State or local agency responsible for underground storage tanks. If you are not sure which agency to contact, start with your local fire department.

For general information on the national UST program, you can call EPA's toll-free Hotline number, 1-800-424-9346.

LIST OF VENDORS

Liquid Sensors

Detector Type	Company	Address	Phone	Product
MANUAL				
Grab Samplers	NEPCCO	29 Wall St. Foxboro, MA 02035	617-543-8458	Liquid Samplers and Bailers
	Norton Chemplast	150 Dey Rd. Wayne, NJ 07470	201-696-4700	Bailers
	(many others)			
Chemical-Sensitive Paste	Kolor Kut Products	P.O. Box 5415 Houston, TX 77262	713-926-4780	Water & Gasoline Finding Pastes
	J.H. McCabe Co., Inc.	P.O. Box 822 Short Hills, NJ 07078	201-635-0963	Water & Gasoline Indicator Pastes
AUTOMATIC				
Interface Probe Monitor	Comar, Inc.	P.O. Box 832676 Richardson, TX 75083	214-238-7691	*Models 807, 808, & 809 Tank Monitors *PLD-17 Pipeline
Monitor Gauging	EMTEK, Inc.	27 Harvey Rd. Bedford, NH 03210	603-627-3131	Electronic Well Light (EWGL-12)
	Marine Moisture Control	60 Inip Dr. Inwood, NY 11696	718-327-3430 800-645-7339	Sonic Ullage Interface Probe
	Groundwater Technology, Inc.	220 Norwood Park S. Norwood, MA 02062	617-769-7600	Interface Probe
Product Soluble Devices	EMTEK, Inc.	27 Harvey Rd. Bedford, NH 03102	603-627-3131	Detectron
	IFP Enterprise	680 Fifth Ave. New York, NY 10019	212-265-3800	Oil Fuse
	In-Situ, Inc.	210 South 3rd St. Laramie, WY 82070	307-742-8213	Petrochemical Release Monitors
	K&E Associates	3312 Industry Dr. Long Beach, CA 90806	213-424-1517	PMS-800

Detector Type	Company	Address	Phone	Product
Product Soluble Devices (Cont.)	Pump Engineer Associates	921 National Ave. Addison, IL 60101	312-543-2214	Sentinel
	Technology 2000, Inc.	265 Ballardvale St. Wilmington, MA 01887	617-658-2900	TOLTECH Hydrocarbon Monitor
Electrical Resistivity Sensors	Control Devices	2009-A West Detroit St. Broken Arrow, OK 74012	918-251-0387	Wik-Stik
	Total Containment	15 E. Uwchlan Ave. Exton, PA 19341	215-524-9274	Total Containment Cable-TC3000
Thermal Conductivity Devices	FCI	1755 LaCosta Meadows Dr. San Marcos, CA 92069	800-854-1993 615-744-6950	785 Leak Detection Systems
	Leak-X	560 Sylvan Ave. Englewood Cliff, NJ 07632	201-569-8989	Leak-X System
	Groundwater Technology, Inc.	220 Norwood Park S. Norwood, MA 02062	617-769-7600	CMS Variable Level System
Pollulert Systems (Mallory)		P.O. Box 706 Indianapolis, IN 46206	317-636-5353	FD102 and FD103
	Universal Sensors and Devices, Inc.	9205 Alabama Ave, Unit C Chatsworth, CA 91311	818-998-7121	Leak Alert System

Vapor Sensors

MANUAL				
Detector Tubes	MSA	10770 Moss Ridge Road Houston, TX 77043	800-672-2222 713-690-6268	Samplair Pump & Test Kit
	National Draeger, Inc.	P.O. Box 120 Pittsburgh, PA 15230	412-787-8383	Gas & Vapor Detection Products
Combustible Gas Detectors	MSA	P.O. Box 426 Pittsburgh, PA 15230	800-672-2222 412-967-3000	Several models

Detector Type	Company	Address	Phone	Product
Photoionization Detectors	AID, Inc.	Rt. 41 & Newark Rd. Avondale, PA 19311	215-268-3181	Model 580
	Astro Int. Corp.	100 Park Ave. League City, TX 77573	713-332-2484	Trace Gas Analyzer-1010
	HNU	160 Charlemont St. Newton Highlands, MA 02161	617-964-6690	Model PI 101
	Photovac International	741 Park Ave. Huntington, NY 11743	516-351-5809	*TIP *Underground Tank Monitor
Portable GCs	AID, Inc.	Rt. 41 & Newark Rd. Avondale, PA 19311	215-268-3181	Model 590
	HNU	160 Charlemont St. Newton Highlands, MA 02161	617-964-6690	Models 201,301D, 501
	Microsensor Technology Inc.	41762 Christy St. Fremont, CA 94538	415-490-0900	Michromonitor
	Photovac, Inc.	739B Park Ave. Long Island, NY 11743	516-351-5809	Photovac 10A10
	Sentex Sensing Tech., Inc.	553 Broad Ave. Ridgefield, NJ 07657	201-945-3694	Scentor
	XON Tech	6862 Hayvenhurst Ave. Van Nuys, CA 91406	818-787-7380	GC-810
FIDs	Foxboro Analytical	330 Neponset Ave. Foxboro, MA 02035	617-543-8750	Century OVA
Infrared	Foxboro Analytical	330 Neponset Ave. Foxboro, MA 02035	617-543-8750	Miran
	Horiba Instrumental	121 Duryea Ave. Irvine, CA 92714	800-446-7422	IR Hydrocarbon Gas Analyzer
AUTOMATIC				
Catalytic Sensor Devices	Bacharach Instrument Co.	625 Alpha Dr. Pittsburgh, PA 15238	412-963-2235	*TLV Sniffer *Model 303 *Model H
Gaspointer	Gas Tech, Inc.	8445 Central Ave. Newark, CA 94560	415-794-6200	Model 1238

Detector Type	Company	Address	Phone	Product
Catalytic Sensor Devices (Cont.)	Industrial Scientific Devices Corp.	355 Steubenville Pike Oakdale, PA 15071	412-788-4353	LD-222
	Intek Corp.	P.O. Box 42821/606 Houston, TX 77042	713-498-5855	IGD
	Lumidor Safety Products	5364 NW 167th St. Miami, Florida 33014	305-625-6511	Model CRP-1
	Detector Electronics	207 East Java Dr. P.O. Box 3566 Sunnyvale, CA 94088	408-734-1221	Combustible Gas Detection System
Metal Oxide Semiconductors	API/Ronan	12410 Benedict Ave. Downey, CA 90242	213-428-7541	TRS 76
	Armstrong Monitoring	215 Colonade Rd. S. Nepean, Ontario Canada K2E 7K3	613-225-9531	4200 Sensor
	Azonic Technology Corp.	1671 Mabury Rd. San Jose, CA 95133	408-729-4900	Enviro-Ranger
	Calibrated Instrument, Inc.	731 Saw Mill River Rd. Ardsley, NY 10502	914-693-9232	Pure Air Monitor
	Enmet Corp.	2308 S. Industrial Hwy. Ann Arbor, MI 48104	313-761-1270	Several models
	Genelco, Inc.	11649 Chairman Dr. Dallas, TX 75243	214-341-8410	Soil Sentry
	Harco Technologies Corp.	1216 E. Tower Rd. Schaumberg, IL 60195	312-882-3777	Multi Ram 12
	International Sensor Technology	17771 Fitch St. Irvine, CA 92714	714-863-9999	AG5000 & AG5100
	MSA	600 Penn Center Blvd. Pittsburgh, PA 15235	412-776-8802	Tankgard
	Groundwater Technology, Inc.	220 Norwood Park S. Norwood, MA 02062	617-769-7600	Vapor CMS
	Sierra Monitor	1991 Tarob Court Milpitas, CA 95035	408-262-6611	Model 201
Metal Oxide	Universal	9205 Alabama Ave.	818-998-7121	Leak Alert

Detector Type	Company	Address	Phone	Product
Semiconductors (Cont.)	Sensors and Devices, Inc.	Unit C Chatsworth, CA 91311		
	U.S. Industrial Products Co.	13564 Pumice St. Norwalk, CA 90650	213-921-4342	Tank Monitor
Product Permeable Devices	Teledyne Geotech	3401 Shiloh Rd. Garland, TX 75041	214-271-2561	LASP System
	W.L. Gore	1505 N. 4th St. Flagstaff, AZ 86002	602-526-1290	LEAKLEARN
Diffusion Sensors	Adsistor Technology	11300 N.E. 25th St. P.O. Box 98115 Seattle, WA 98125	206-523-6468	Adsistor Sensor
	Emco Wheaton	Chamberlain Rd. Conneaut, OH 44030	216-599-8151	Leak Sensor II Vapor Probe
	EMMCO, Inc.	2525 Lehigh Pl. Costa Mesa, CA 92626	714-545-6030	Env. Control Safety Monitoring System
	Spearhead Tech., Inc.	P.O. Box 51160 Seattle, WA 98115	604-688-8245	STI 2X12 Inground Tank Monitor